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APPLICATION FOR A STANDARD PATENT

I/We, DATAPLEX PTY. LTD.

of 28 John Street, Lilydale, Victoria 3140, Australia.

hereby apply for the grant of a standard patent for an invention entitled

WIRELESS DATA TRANSMISSION LINK

which is described in the accompanying provisional/~~complete~~ specification.

~~Details of basic application(s):~~

Number of basic application	Name of Convention country in which basic application was filed	Date of basic application

$ 60 ATTACHED

My/our address for service is care of CLEMENT HACK & CO., Patent Attorneys, 601 St. Kilda Road, Melbourne, 3004, Melbourne, Victoria, Australia.

DATED this 22nd day of June 1987.

DATAPLEX PTY. LTD.

CLEMENT HACK & CO.

To: The Commissioner of Patents.

PF/App/ 2/81

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(71) Applicant
DATAPLEX PTY. LTD.
(72) Inventor
NAME NOT GIVEN
(74) Attorney or Agent
GRIFFITH HACK & CO. MELBOURNE

(57) Claim

1. A method of establishing a wireless data transmission link between a first data link device and a second data link device, the method comprising:

(a) establishing a duplex link between said first data link device and said second data link device by

(i) transmitting an identification electromagnetic signal from said first data link device, then

(ii) receiving said identification electromagnetic signal at said second data link device, then

(iii) recognizing if said identification electromagnetic signal is intended for said second data link device, then

(iv) transmitting an acknowledging electromagnetic signal from said second data link device, then

(v) detecting said acknowledging electromagnetic signal at said first data link device, and only then

(b) commencing data transfer.

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Form 10

PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE

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Priority

Related Art:

TO BE COMPLETED BY APPLICANT

Name of Applicant: DATAPLEX PTY. LTD.

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Complete Specification for the invention entitled: WIRELESS DATA TRANSMISSION LINK

The following statement is a full description of this invention, including the best method of performing it known to me:—

PF/CP1F/2/80

WIRELESS DATA TRANSMISSION LINK

The present invention relates to a method and apparatus for establishing a wireless data transmission link, and relates particularly but not exclusively to such for use between a first data apparatus and a second data apparatus.

Conventional remote data capturing and transferring systems have distinct limitations since they typically employ radio techniques or run physical cables for the duration of the data dump. Using physical cables is a slow and inefficient technique, whereas a radio link requires expensive licensing and must accommodate to the limitations of an already crowded spectrum. In view of the above disadvantages,

both of these known techniques are undesirable in a low power, short distance, high speed application of the kind outlined below.

The present invention was developed with a view to providing an improved wireless data transmission link which would allow high speed data transfer while substantially reducing the problems associated with the prior art techniques.

According to one aspect of the present invention there is provided a method of establishing a wireless data transmission link between a first data link device and a second data link device, the method comprising:

(a) establishing a duplex link between said first data link device and said second data link device by

(i) transmitting an identification electromagnetic signal from said first data link device, then

(ii) receiving said identification electromagnetic signal at said second data link device, then

(iii) recognizing if said identification electromagnetic signal is intended for said second data link device, then

(iv) transmitting an acknowledging electromagnetic signal from said second data link device, then

(v) detecting said acknowledging electromagnetic signal at said first data link device, and only then

(b) commencing data transfer.

Most preferably the method includes increasing the power of the electromagnetic transmission when the data is transferred whereby data transmission errors can be minimized.

According to a further aspect of the present invention there is provided a data link device for establishing a wireless data transmission link between a first

data apparatus and a second data apparatus, each of said first data apparatus and said second data apparatus having a respective data link device, the device comprising:

a transmitter and a receiver, said transmitter having transmitting means for transmitting an identification electromagnetic signal, said receiver having receiving means for receiving an acknowledging electromagnetic signal transmitted from the data link device at the other data apparatus upon receipt of said identification signal thereat; and

control means for allowing data transfer only when said acknowledging signal is received.

Most preferably the control means controls power increasing means for increasing the transmitting power of said transmitting means when said acknowledging signal is received, whereby data transmission errors can be minimized in a data transfer mode.

According to a still further aspect of the present invention there is provided apparatus for establishing a wireless data transmission link between a base station and a mobile station, the apparatus comprising:

at the base station a transmitter/receiver;

at the mobile station a receiver/transmitter;

said base station having means for transmitting an identification electromagnetic signal for detection by said mobile station when in proximity thereto, said mobile station having means for transmitting an acknowledging electromagnetic signal upon identifying said identification signal by a signal identifying means, said base station having an acknowledging signal detecting means for detecting said acknowledging signal and control means for allowing data transfer only when said acknowledging signal is detected.

Most preferably said base station of the apparatus is provided with transmission power increasing means for increasing transmission power and wherein said control means is responsive to said acknowledging signal detecting means detecting said acknowledging signal so that data can then be

transmitted from said base station to said mobile station at said increased transmission power whereby data transmission errors can be minimized.

A preferred embodiment of the prevent invention relates to a mobile, typically vehicularly mounted, infrared optical data link which allows digital data to be transmitted between a fixed base station such as a gate house or loading dock and a mobile station such as a vehicle. A particular advantage of this embodiment is that it enables vehicle performance, orders, delivery and other information collected by the driver and/or salesman to be stored in a portable computer onboard the vehicle, which information can be rapidly transferred to a central computer when that vehicle returns to the depot. Conversely, despatch information such as routes to take, deliveries to make and calls to complete, can be transferred quickly from the base station computer to the terminal in the vehicle. Employing a wireless data transmission link in this situation greatly reduces the paper work involved using conventional methods, and improves the turn around time of the delivery vehicles.

In order that the invention can be more clearly understood a preferred embodiment will now be described with reference to the accompanying drawings. Although the following description will be given with reference to an infrared optical data link, it will be apparent that the present invention is not limited to optical wave lengths but may alternatively employ other parts of the electromagnetic spectrum such as for example radio frequencies or microwave frequencies. The invention is particularly advantageous for establishing a wireless data transmission link between a fixed site and a mobile site, however it may be used equally successfully between two fixed sites or two mobile sites. Furthermore, although the following description is given with reference to a wireless data transmission link between a central computer and a mobile computer terminal, the link may be employed between any two data apparatus which are suitable for capturing, storing, and/or processing information in

digital format. Throughout the specification the term "duplex" is used to describe the operation of transmitting and receiving apparatus at either end of the transmission link, and covers both half duplex and full duplex operation. In the accompanying drawings:

Figure 1 illustrates schematically a preferred embodiment of the apparatus for establishing a wireless data transmission link between a base station and a mobile station;

Figure 2 is a circuit diagram of a preferred embodiment of a data link device used in the apparatus of Figure 1;

Figure 3 is a further circuit diagram illustrating the internal logic of IC1 in Figure 2; and

Figure 4, Figure 5, Figure 6 and Figure 7 are timing diagrams for the circuit illustrated in Figure 3.

Referring to Figure 1 there is illustrated schematically a preferred form of the apparatus for establishing a wireless data transmission link between a base station 10 and a mobile station 12. The base station 10 is typically at a fixed site and comprises a first data link device 14 connected via a switching means 16 to a first data apparatus 18. Data apparatus 18 is typically a central computer, such as an IBM personal computer, which may be linked to a larger general purpose computer having the main data base or accounting, delivery and invoicing information stored therein. Switching means 16 is responsive to the first data link device 14 to activate an indicating means 20 for indicating that a data transmission link has been established and that data transmission is taking place or is about to take place. Indicating means 20 may typically consist of a visible light and/or audible alarm located where it can be seen or heard by the driver of the mobile station 12 as he approaches the base station 10.

Mobile station 12 comprises a second data apparatus 22 connected to a second data link device 24. The second data apparatus 22 typically consists of a mobile computer terminal such as a hand held terminal, a portable computer, a lap-top

computer or a purpose-built unit. The data link devices 14 and 24 are substantially identical and will be described in greater detail below. Control software, resident in both the mobile and fixed computers or terminals, preferably controls the data link devices and optionally the application and system software in the host computers and/or terminals. The control software may be configured by the user and typically controls the sequence of steps used to establish a duplex data transmission link. The method of establishing a duplex wireless data transmission link between the first data link device 14 and the second data link device 24 will now be described with reference to Figure 1.

At initialization, the fixed site central computer 18 raises Request To Send (RTS) when the system is up and running and ready to exchange data with a mobile station. Each data link device is adapted to transmit a low power electromagnetic signal whenever RTS is up. Furthermore, the computer or terminal attached to a particular data link device will also constantly repeat a short message, perhaps only one character long, which identifies that computer or terminal, whenever RTS is up. Consequently, whenever a data link device is transmitting in a low power or search mode, it will be transmitting an identification electromagnetic signal determined by the attached computer or terminal. Preferably the radiated field pattern from the data link device is restricted to a controlled beam shape so that the possibility of secure data being intercepted by third parties is minimized. Under software control the fixed site computer may either raise RTS just for the time of sending each character or raise RTS for the entire duration of the search and message transfer phase.

When a mobile station 12 enters the radiated field of the first data link device 14, the second data link device 24 of the mobile station 12 will receive the identification electromagnetic signal and after a short time interval will raise data carrier detect (DCD) to the second data apparatus 22. Received data (RD) identifying the fixed computer of the

data apparatus 18 at the base station 10 is passed to the mobile terminal 22 of the mobile station 12 by the second data link device. On receipt of DCD and RD, the mobile terminal 22 checks whether the base station identifier is a valid address, and assuming both a valid address and the need to transmit data, the mobile terminal 22 will raise its own RTS which will cause the second data link device 24 to transmit a carrier, either low or high power depending on the state of DCD, and containing either a steady mark or mobile station identification under software control from the mobile computer terminal. Transmit data (TD) identifying the mobile terminal 22 is passed to the second data link device 24 to be transmitted to the first data link device 14 as an acknowledging electromagnetic signal. The presence of both RTS and DCD at the second data link device 24 causes it to send clear to send (CTS) to the mobile terminal 22.

At the base station 10, the radiated field from the mobile station 12, including the acknowledging electromagnetic signal, will be detected by the first data link device 14 and the simultaneous presence of RTS and DCD at the first data link device 14 causes it to grant CTS to the fixed computer 18. Switching means 16, located between the first data link device 14 and the first data apparatus 18 of the base station 10, is adapted to respond to the CTS signal to activate the visible or audible indicating means 20 informing the driver of the mobile station 12 to stop the vehicle since it is in an acceptable position for reliable data transfer. The driver must stop immediately the indicating means 20 is activated and should not move off until data transfer has concluded as evidenced by the indicating means 20 being extinguished.

In the event that the mobile station 12 is not correctly positioned, either to receive the radiated electromagnetic signal from the base station 10, or to transmit an electromagnetic signal to the base station 10 in order to establish the duplex transmission link with an acceptable low data error rate, the control software can be arranged to alternately raise and lower RTS to the data link

device 14 or 24. This will have the effect of alternately raising and lowering CTS at the base station 10 causing the indicating means 20 to be alternately activated and deactivated by the switching means 16. The flashing light of indicating means 20 informs the driver than an unacceptably high data error rate exists in the data transmission link and that he will need to reposition the vehicle.

The data link devices 14 and 24 are configured so that the simultaneous presence of both RTS and DCD at both the base station and the mobile station will cause both devices to transmit at full power.

Using the above method a full duplex wireless data transmission link is established initially at low power, then increased automatically to full power to improve the signal to noise ratio and thus reduce the error rate during data transfer. Although the background error rate will be low because of the transmission link signal strength is well above the detection threshold, there will always be the possibility of some errors arising. Therefore block checking in the control software using a cyclic redundancy check is recommended to ensure end to end data integrity.

After the data has been transferred successfully, either end of the transmission link can drop RTS. If the mobile terminal 22 drops RTS, the mobile transmitter will be turned off and the base station indicating means 16 will be extinguished since the first data link device 14 will no longer provide CTS to the fixed computer 18. It will be recalled that the necessary condition for CTS to be granted by a data link device is the presence of both RTS and DCD. Once the indicating means 20 is extinguished, the mobile station 12 is free to leave the area. Alternatively, if the fixed computer 18 at the base station 10 drops RTS, again the switching means 16 will extinguish the indicating means 20 since CTS is no longer present. As the mobile station 12 moves away, the base station 10 software waits for a short period, for example 10 seconds, before raising RTS again and waiting for the next vehicle. The structure and operation of

a preferred embodiment of the data link device will now be described in greater detail with reference to Figures 2 to 7 of the accompanying drawings.

For reasons of economy, performance, data security and ease of licensing, the preferred signalling means for the data link device is infrared energy, however visible light, microwave, RF and any other wireless communication technique can be used.

Referring to Figure 2 there is shown a circuit diagram of a preferred embodiment of a data link device that may be used in the apparatus of Figure 1. The data link device of Figure 2 comprises a transmitter 40 having transmitting means 42, a receiver 44 having receiving means 46 and a control means 48. In this embodiment the information content in the transmitted infrared radiation is transmitted using Pulse Width Modulation (PWM) in accordance with the data sent from the data apparatus connected to the device. The transmitting means 42 of the transmitter 40 comprises an array of infrared light emitting diodes (IREDs) shown in Figure 2 as LED1, LED2, LED3 and LED4. The LEDs are pulsed with two pulse widths of either 1.628 or 13.021 microseconds. A short pulse signals a data mark or 1, for the OFF condition and a long pulse signals a space or 0, for the ON condition. These pulse widths are digitally controlled by the control means 48. The timing ratio of 1:8 is chosen to allow unambiguous discrimination at the receiver 44 of a corresponding data link device, even with considerable pulse width smearing in the receiver electronics. The pulse amplitude to the transmitting means 42 is varied from low current, when in the low power search mode, to full current when in the high power data transfer mode of the data link device.

The receiver 44 comprises an optical filter (not shown) located in front of the receiving means 46 to reduce interference from visible light sources such as daylight, fluorescent and incandescent light globes, and discharge lamps. The receiving means 46 consists of an infrared PIN diode detector D1. Receiving means 46 is followed by a stable

fixed gain amplifier which has its frequency response controlled to minimize gain at low frequencies to ensure rejection of mains powered stray light sources and to maximise response to the desired signal. A tracking comparator U1C is used to detect any signal greater than a predetermined threshold value and convert this into a digital logic signal whose pulse width replicates the transmitted pulse width. This digital logic signal, (Rx In to IC1) is also monitored by comparator U1D which comprises a proximity, or signal or carrier detect section 50. The time constants and discharge resistor values of the carrier detect section 50 are selected so that approximately 100 milliseconds of signal must be present at the input of U1D before the DCD line into IC1 is enabled. This ensures that short noise bursts are not passed to the data output RD line as the mobile station 12 moves around and encounters stray noise sources.

The fixed gain amplifier of the receiver 44 includes a field affect transistor (FET) Q1 which provides impedance matching for the electrical signal produced by the PIN diode detector D1 in order to provide maximum power transfer. Source bypass capacitor C2 reduces the gain of the FET at low frequencies by retaining high gain at the desired frequencies. Transistor Q3 provides a shaped response fixed gain amplification and has low gain outside the desired frequency range. Transistor Q2 is operated from a regulated +5 volt supply and serves to set the reference bias voltage of the comparator U1C at 100 millivolts, as well as delivering a controlled gain of 10 to the desired signal. The voltage at the junction of resistors R12 and R14 is averaged by resistor R13 and capacitor C13 and fed to the inverted input of comparator U1C. The desired signal (Rx SIG) is a fast positive-going pulse at the collector of transistor Q2 and this is passed directly to the non-inverting input of the comparator U1C. Providing the pulse amplitude of the signal exceeds the comparator threshold, set by the steady collector

current through resistor R14, comparator U1C will fire and produce a digital representation of the received signal at its output.

The logic for the pulse width and amplitude encoder of the transmitter 40 and the decoder of the receiver 44, together with the gating of RTS, CTS and DCD is all contained in the control means 48. Preferably the control means 48 comprises an integrated circuit IC1 which embodies the digital logic of the data link device using flip flops and various gate circuits. Advantageously all of the digital logic embodied in IC1 can be configured using a single erasable programmable logic device chip of the kind manufactured by Altera Corporation.

The data link device requires a single voltage source in the range 8 to 16 volts and an onboard power supply to generate the regulated +5 volts for the logic and the +/-8 volts for the RS232 computer interface (Industry Standard V.24). Data and control information from the computer or terminal connected to the data link device, enters and leaves the device via a cable with a small connector at industry standard V.24 signal levels directly to and from integrated circuit U4 which is a CMOS line driver/receiver chip. Power enters through the same cable via a reverse voltage protection diode D2 to an energy storage and voltage smoothing capacitor C8. The nominal +10 volts DC is regulated down to a stable +5 volts by voltage regulator VR11. The negative supply rail for the V.24 driver chip U4 is generated by integrated circuit U3. The data link device includes a crystal oscillator 54 which operates continuously at a multiple of the data rate to ensure accurate timing information and repeatability between devices with no manufacturing or set-up adjustments. IC1 drives the crystal oscillator and its internal counter/divider chains at all times that power is supplied. The configuration and operation of the control means 48 will now be described with reference to Figures 3 to 7.

Referring to Figure 3 there is shown a further circuit diagram illustrating the internal logic of IC1 including the transmitter encoder section and the receiver decoder section of the control means 48. The transmitter encoder section comprises a pair of up/down counters 60 for controlling the width of transmitted pulses in accordance with the binary state of the transmit data (TD) line at the input of the transmitter encoder section. Whenever RTS is raised, pulses representing the binary state of the TD line are passed to the low power IRED array driver Q4 via the low power output line LO out. If the incoming TD line goes to the space condition, a fast reset pulse (TD reset) is generated within the transmitter encoder section to reset the transmit counters 60 (see Figure 4). This enables centre sampling of the TD bits and synchronisation of the remote receiver. At the centre sample time, the TD pulser section 62 sends the pulse width representation of the TD line to both the low and high power output driver sections 64. The TD pulser section 62 comprises a D flip flop with space and mark pulse width signals and appropriate gating. RTS must be present before the pulse width representation of the TD line is sent to the output driver sections 64 from the TD pulser section 62. When RTS goes high, output pulses on the Lo out line are enabled to the low power driver transistor Q4 (See Figure 2). Resistor R21 in Figure 2 limits the pulse amplitude to the transmitter IRED array when in the low power search mode. If both RTS and DCD are present, output pulses are enabled on both the Lo out and Hi out lines of the output driver sections 64 into both the low and high power driver transistors Q4 and Q5 respectively in Figure 2 which comprise a transmission power increasing means 52. AND gate 65 in Figure 3 provides for the ANDing of RTS and DCD to switch the data link device from the lower power search mode to the high power data transfer mode. A further AND gate 66 is provided to AND RTS and DCD and provide the Clear To Send signal CTS. Resistors R22 and R23 in Figure 2 together with other stray internal resistances in the IREDs and transistors, limit the peak current to the IRED

array. High power pulse drive is handled by transistor Q5. Electrical energy for the IRED array is supplied by capacitor C9, and resistor R24 serves to limit noise from the transmitter 40 passing back into the power supply circuitry.

The receiver decoder section of the control means 48 illustrated in Figure 3 also includes a pair of updown counters 68. Counters 68 are controlled by a clock signal from the crystal oscillator and comprise part of a pulse width detector which outputs a 1 to the received data (RD) line whenever the incoming pulses are narrow, and a 0 whenever the pulse width is wide. Incoming pulses are fed from the output of comparator U1c in Figure 2 to the Rx In line of the control means 48 in Figure 3. As with the transmitter encoder section, the receiver decoder section also generates a reset pulse (Rx reset) whenever the incoming Rx In line goes to the spaced condition. This enables the receiver decoder section to determine whether the incoming pulses are narrow or wide. The decision point is set at 6.510 microseconds. Narrow pulses can be stretched from their correct 1.628 microseconds, or wide pulses can be shortened from their correct 13.021 microseconds, by a considerable margin before data errors can occur (see Figures 6 and 7). In the absence of DCD, the RD line output is clamped to the mark or 1 state so that spurious pulses appearing on the Rx In line do not appear on the RD output line of the receiver encoder section of IC1.

The above described embodiment of the data link device is particularly advantageous because the data error rate can be reduced to very low levels by the novel technique of first radiating a low power search mode signal which is increased to full power when another data link device is detected nearby. Furthermore, unlike a simple modem link, clear to send (CTS) is not granted to the computer or terminal connected to the device until the data transmission link is established in both directions. False triggering of the proximity or data carrier detect section 50 is avoided since a repetitive signal resembling the correct wave form must be present for a few thousand cycles before the DCD line goes

high to the control means 48. Wave length filtering before the receiver 44 reduces stray interference, and careful shaping of the receiver amplifier frequency response characteristics ensures immunity to most noise sources encountered as the mobile station 12 moves around its normal route.

The life time of the transmitting means 46 is significantly improved by using the lower power search mode at all times while another data link device is not detected. The transmitting means 46 of the data link device will have over 10 years service life assuming 10 trips per day, 360 days per year and 8 kilobytes of data per transfer. Interestingly, even if RTS is low and the device transmitter is off, the presence of another transmitter nearby transmitting an electromagnetic signal at the correct frequency will cause DCD to go high which could be used by the system software to control the device transmitter.

The above described embodiment of the data link device enables the data transmission link to operate at the base band frequency, and the information content (mark or space) is conveyed by using Pulse Width Modulation, which enables the transmitter 40, the receiver 44 and the control means 48 to be of relatively simple construction. However the invention is not limited to this type of base band system and may be embodied using frequency, phase or some other form of modulation requiring more complex receiver and transmitter circuits. Furthermore, the control means 48 in the preferred embodiment is advantageously embodied in the integrated circuit IC1. However, the required digital encoding, decoding and driving may be done equally successfully using a circuit constructed from discrete components.

It will be obvious to persons skilled in the electronics and other related arts that numerous alterations and modifications can be made to the apparatus, method and device, other than those specifically described, without departing from the basic concepts of the invention. All such modifications and alterations are to be considered within the

scope of the invention, the nature of which is to be determined from the foregoing description and the appended claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of establishing a wireless data transmission link between a first data link device and a second data link device, the method comprising:

(a) establishing a duplex link between said first data link device and said second data link device by

(i) transmitting an identification electromagnetic signal from said first data link device, then

(ii) receiving said identification electromagnetic signal at said second data link device, then

(iii) recognizing if said identification electromagnetic signal is intended for said second data link device, then

(iv) transmitting an acknowledging electromagnetic signal from said second data link device, then

(v) detecting said acknowledging electromagnetic signal at said first data link device, and only then

(b) commencing data transfer.

2. A method as claimed in Claim 1, wherein said step of transmitting an identification electromagnetic signal from the first data link device comprises transmitting a low power electromagnetic signal in a lower power search mode.

3. A method as claimed in Claim 1 or Claim 2, wherein said step of transmitting an acknowledging electromagnetic signal from said second data link device comprises transmitting a lower power electromagnetic signal.

4. A method as claimed in any one of Claims 1 to 3, wherein said first data link device is provided at a base station of fixed location and said second data link device is provided at a mobile station.

5. A method as claimed in Claim 4, further comprising the step of indicating to a person at the mobile station that a duplex link has been established after said step of detecting the acknowledging electromagnetic signal at the first data link device.

6. A method as claimed in any one of the preceding claims, wherein said step of commencing data transfer comprises increasing the transmitting power of both said data link devices in a data transfer mode whereby data transmission errors can be minimized.

7. A data link device for establishing a wireless data transmission link between a first data apparatus and a second data apparatus, each of said first data apparatus and said second data apparatus being provided with a respective data link device, the device comprising:

a transmitter and a receiver, said transmitter having transmitting means for transmitting an identification electromagnetic signal, said receiver having receiving means for receiving an acknowledging electromagnetic signal transmitted from the data link device at the other data apparatus upon receipt of said identification signal thereat; and,

control means for allowing data transfer only when said acknowledging signal is received.

8. A data link device as claimed in Claim 7, wherein said control means controls power increasing means for increasing the transmitting power of said transmitting means when said acknowledging signal is received whereby, in use, data transmission errors can be minimized in a data transfer mode.

9. A data link device as claimed in Claim 7 or Claim 8, wherein said transmitting means comprises an array of infra-red light emitting diodes and said receiving means comprises an infra-red detector.

10. A data link device as claimed in Claim 9, wherein said control means further comprises a transmitter encoder section and a receiver decoder section for encoding and

decoding a transmitted or received infra-red electromagnetic signal respectively, whereby, in use, the information content of the infra-red electromagnetic signal can be transmitted using a pulse width modulation technique.

11. An apparatus for establishing a wireless data transmission link between a base station and a mobile station, the apparatus comprising:

at the base station a transmitter/receiver;

at the mobile station a receiver/transmitter;

said base station having means for transmitting an identification electromagnetic signal for detection by said mobile station when in proximity thereto, said mobile station having means for transmitting an acknowledging electromagnetic signal upon identifying said identification signal by a signal identifying means, said base station further having an acknowledging signal detecting means for detecting said acknowledging signal and control means for allowing data transfer only when said acknowledging signal is detected.

12. An apparatus as claimed in Claim 11, wherein said base station is provided with transmission power increasing means for increasing the transmitting power of said base station transmitter, and wherein said control means is responsive to said acknowledging signal detecting means detecting said acknowledging signal so that data can be transferred from the base station to the mobile station at said increased transmission power in a data transfer mode whereby data transmission errors can be minimized.

13. A method of establishing a wireless data transmission link substantially as herein described with reference to and as illustrated in the accompanying drawings.

14. A data link device substantially as herein described with reference to and as illustrated in the accompanying drawings.

15. An apparatus for establishing a wireless data transmission link substantially as herein described with reference to and as illustrated in the accompanying drawings.

DATED THIS 20TH DAY OF JUNE, 1988

DATAPLEX PTY. LTD.
By Its Patent Attorneys:

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Fellows Institute of Patent Attorneys
of Australia.

decoding a transmitted or received infra-red electromagnetic signal respectively, whereby, in use, the information content of the infra-red electromagnetic signal can be transmitted using a pulse width modulation technique.

11. An apparatus for establishing a wireless data transmission link between a base station and a mobile station, the apparatus comprising:

at the base station a transmitter/receiver;

at the mobile station a receiver/transmitter;

said base station having means for transmitting an identification electromagnetic signal for detection by said mobile station when in proximity thereto, said mobile station having means for transmitting an acknowledging electromagnetic signal upon identifying said identification signal by a signal identifying means, said base station further having an acknowledging signal detecting means for detecting said acknowledging signal and control means for allowing data transfer only when said acknowledging signal is detected.

12. An apparatus as claimed in Claim 11, wherein said base station is provided with transmission power increasing means for increasing the transmitting power of said base station transmitter, and wherein said control means is responsive to said acknowledging signal detecting means detecting said acknowledging signal so that data can be transferred from the base station to the mobile station at said increased transmission power in a data transfer mode whereby data transmission errors can be minimized.

13. A method of establishing a wireless data transmission link substantially as herein described with reference to and as illustrated in the accompanying drawings.

14. A data link device substantially as herein described with reference to and as illustrated in the accompanying drawings.

15. An apparatus for establishing a wireless data transmission link substantially as herein described with reference to and as illustrated in the accompanying drawings.

DATED THIS 20TH DAY OF JUNE, 1988

DATAPLEX PTY. LTD.
By Its Patent Attorneys:
CLEMENT HACK & CO.
Fellows Institute of Patent Attorneys
of Australia.

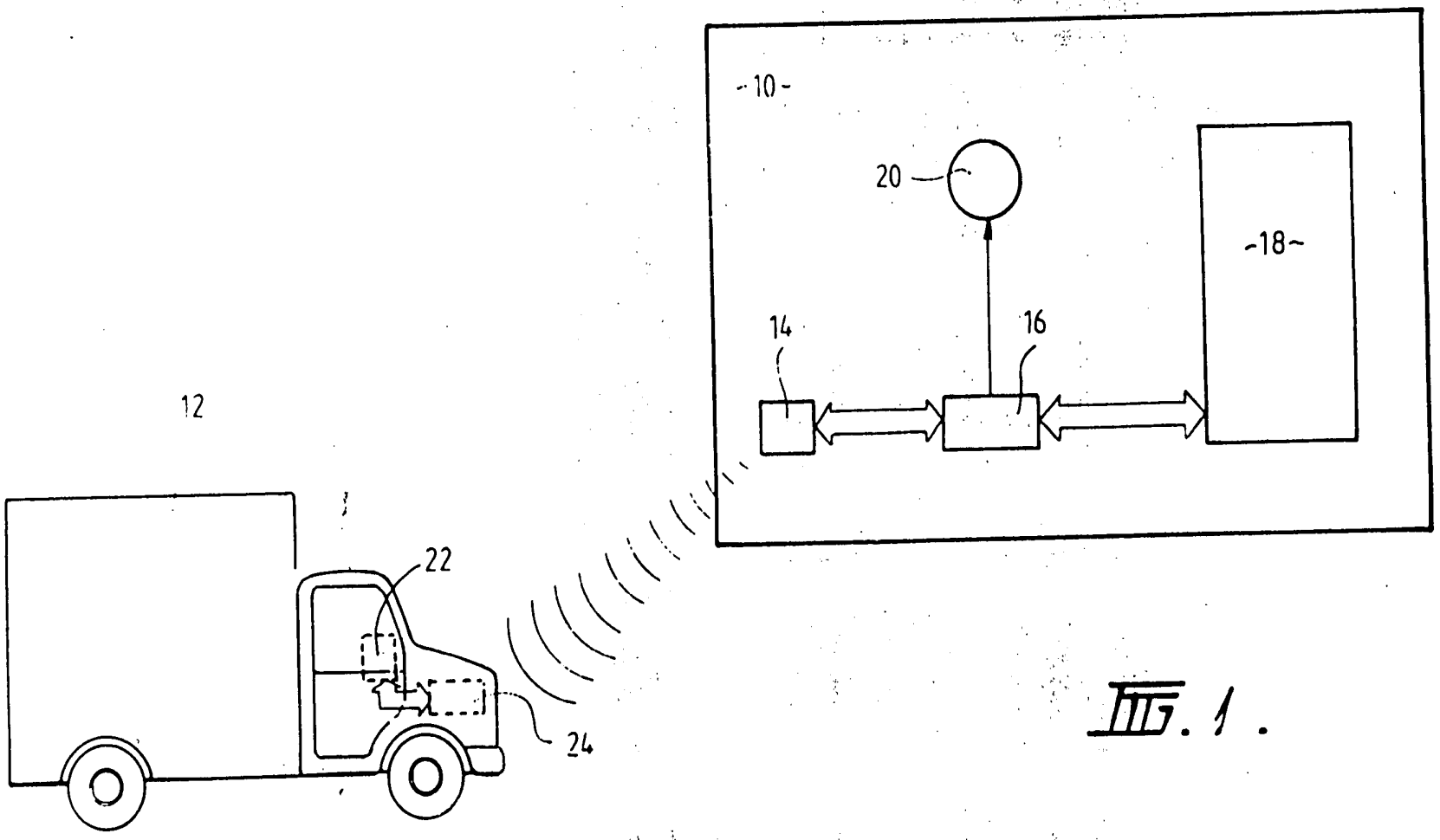
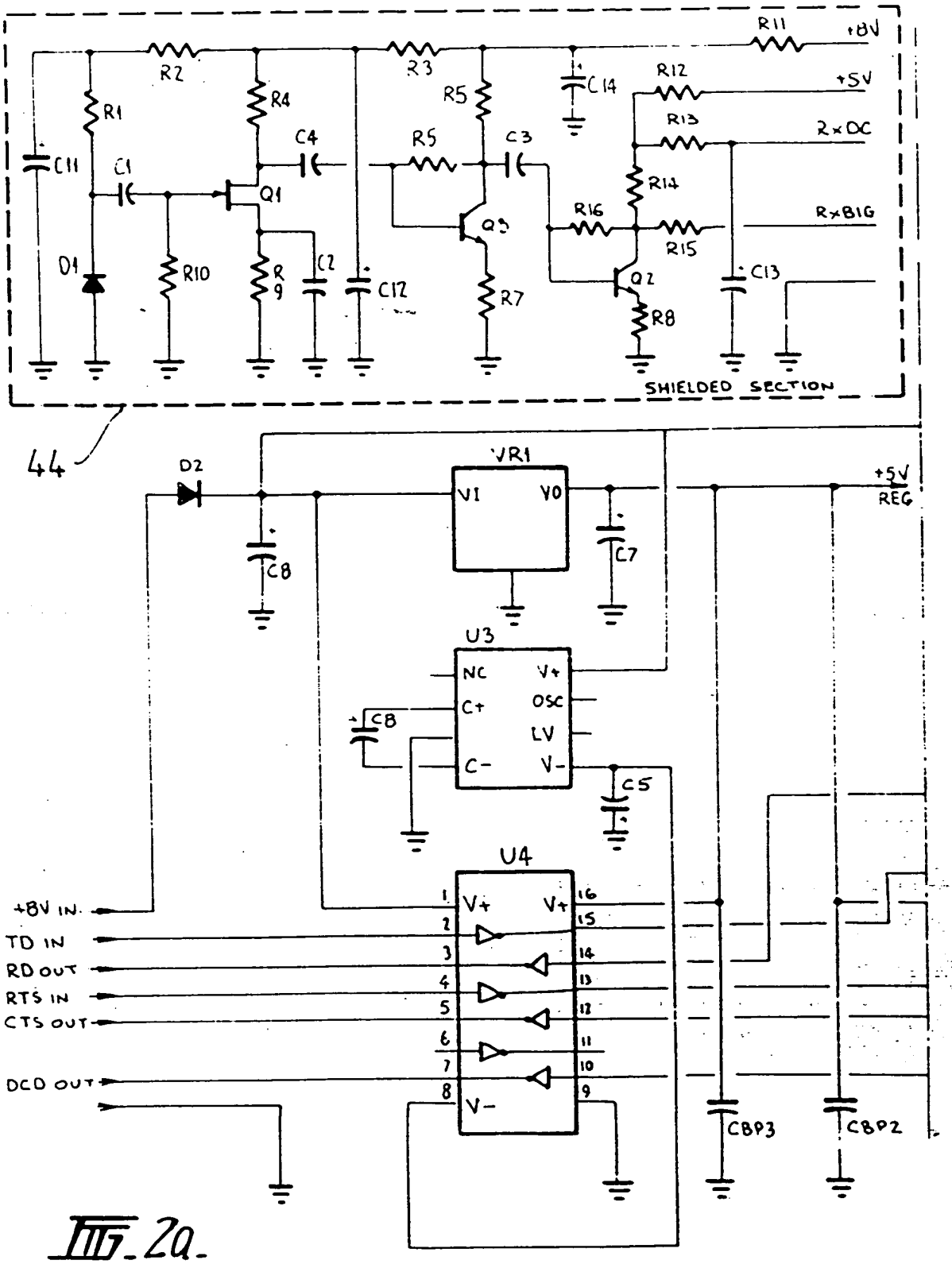


Fig. 1.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Q1
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R16
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Q3
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C2
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R7
Q2
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R8
SHIELDED SECTION
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D2
VR1
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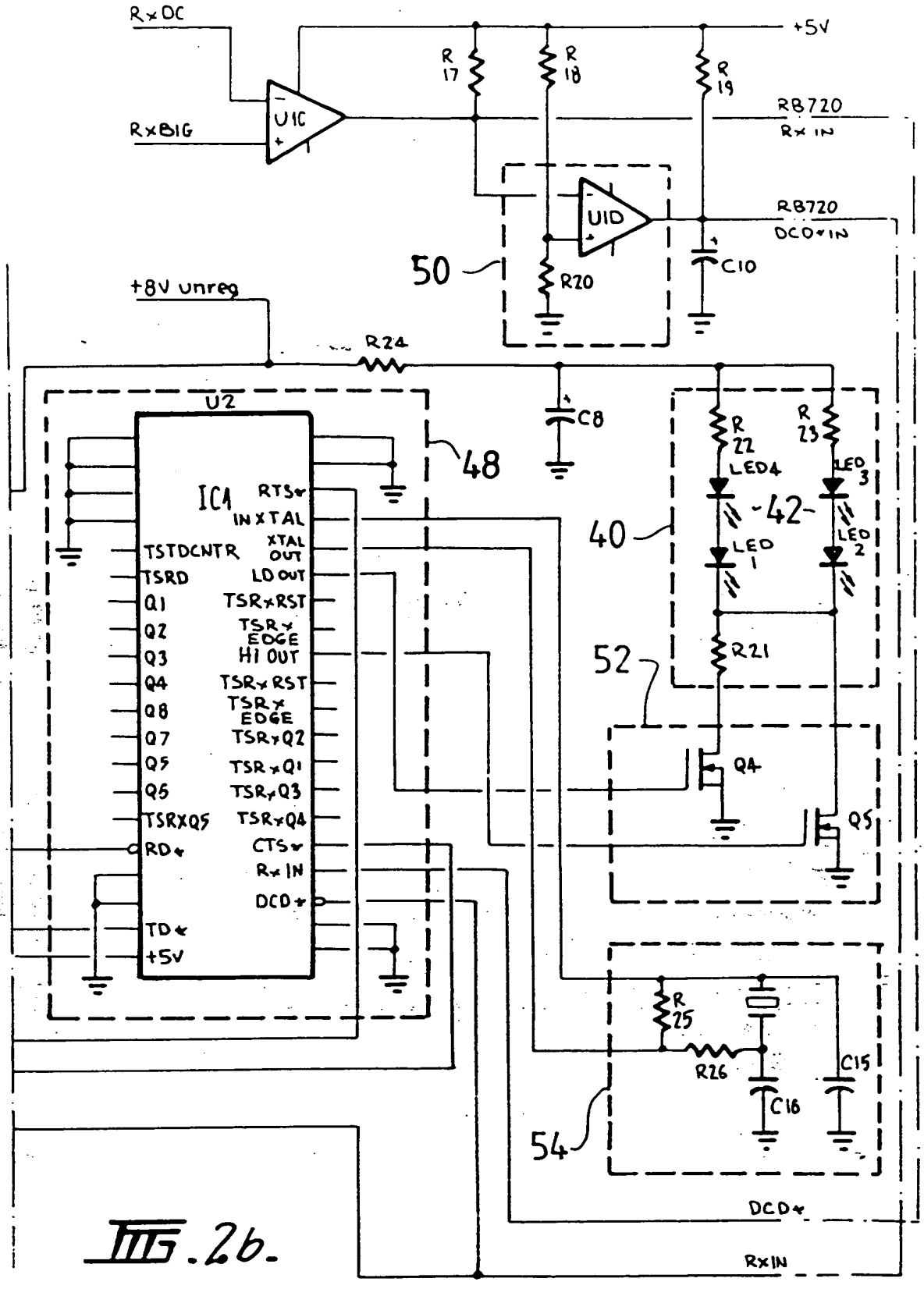
FIG. 2a.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U1C
R17
R18
R19
+5V
RB720
Rx IN
U1D
RB720
DCD IN
50
R20
C10
+8V unreg
R24
C8
U2
48
IC1
RTS
IN XTAL
XTAL OUT
TSTDCNTR
LD OUT
TSRD
TSR RST
Q1
TSR EDGE
Q2
HI OUT
Q3
TSR RST
Q4
TSR EDGE
Q8
TSR Q2
Q7
TSR Q1
Q5
TSR Q3
Q6
TSR Q4
TSRXQ5
CTS
RD
R IN
DCD
TD
+5V
R22
R23
LED4
LED3
42
40
LED1
LED2
R21
52
Q4
Q5
R25
R26
C15
C16
54
DCD
RxIN

FIG. 2b.

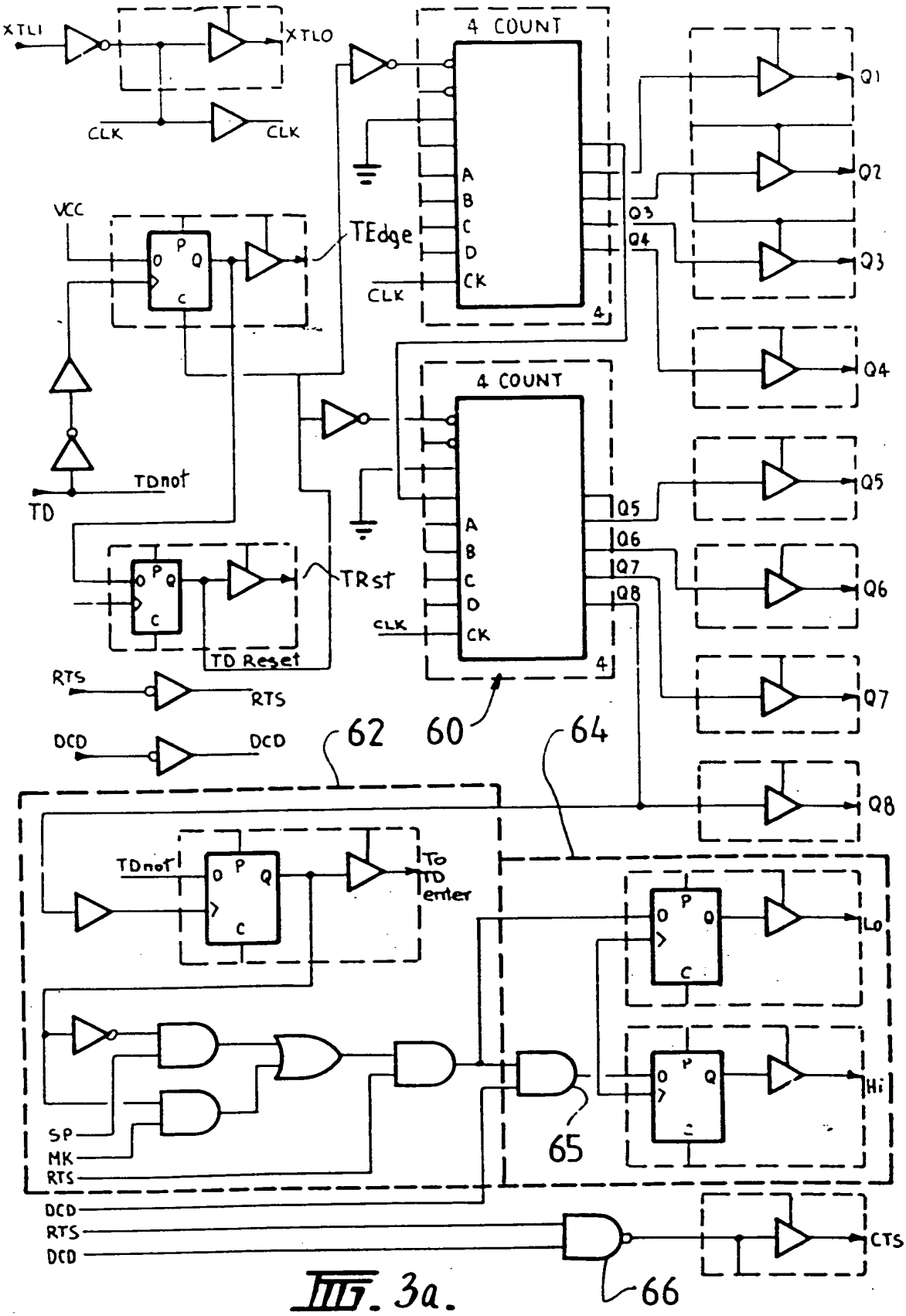
XTLI
XTLO
CLK
CLK
4 COUNT
A
B
C
D
CK
CLK
4
Q1
Q2
Q3
Q4
VCC
TEdge
TDnot
TD
TRst
TD Reset
RTS
RTS
DCD
DCD
62
60
64
4 COUNT
A
B
C
D
CK
CLK
4
Q5
Q6
Q7
Q8
TDnot
To TD enter
Lo
Hi
SP
MK
RTS
65
DCD
RTS
DCD
CTS
66

Fig. 3a.

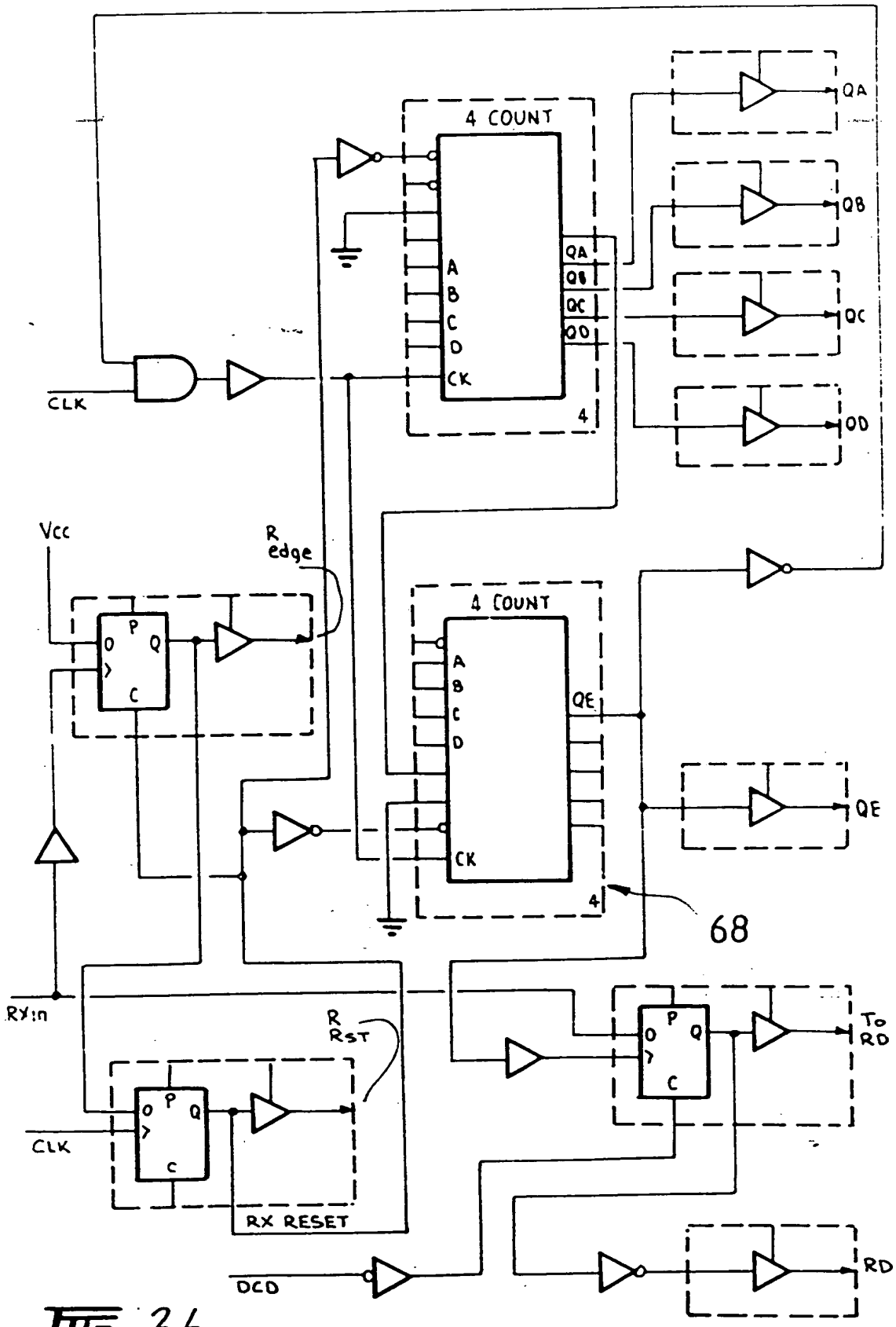
4 COUNT
A
B
C
D
CK
QA
QB
QC
QD
4
CLK
Vcc
R edge
P
Q
C
4 COUNT
QE
68
RXin
R RST
To RD
RX RESET
DCD
RD

FIG. 36.

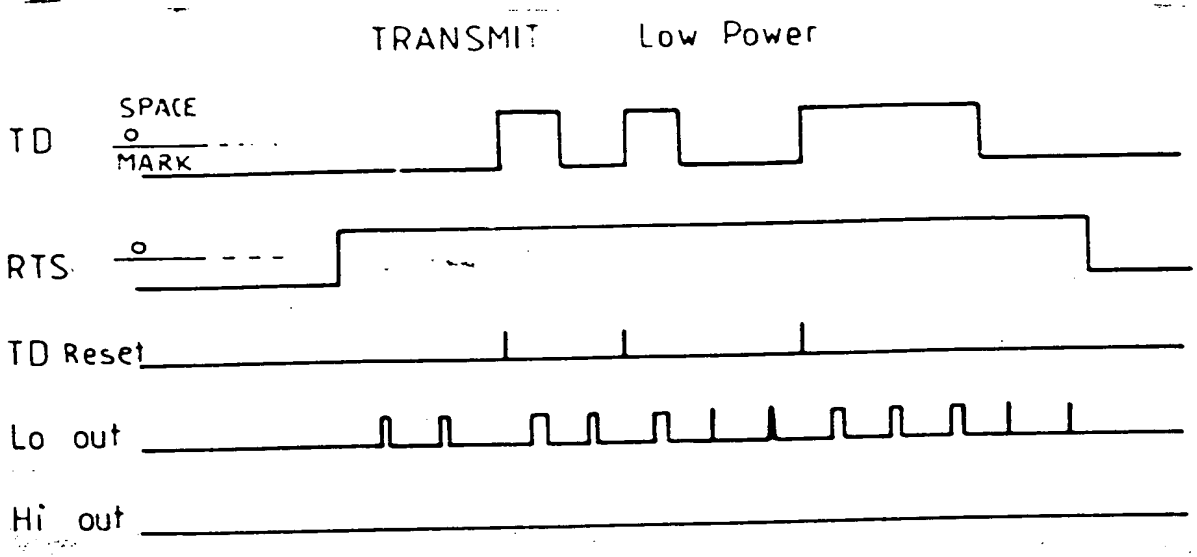
TRANSMIT Low Power
TD
SPACE
MARK
RTS
TD Reset
Lo out
Hi out

FIG. 4.

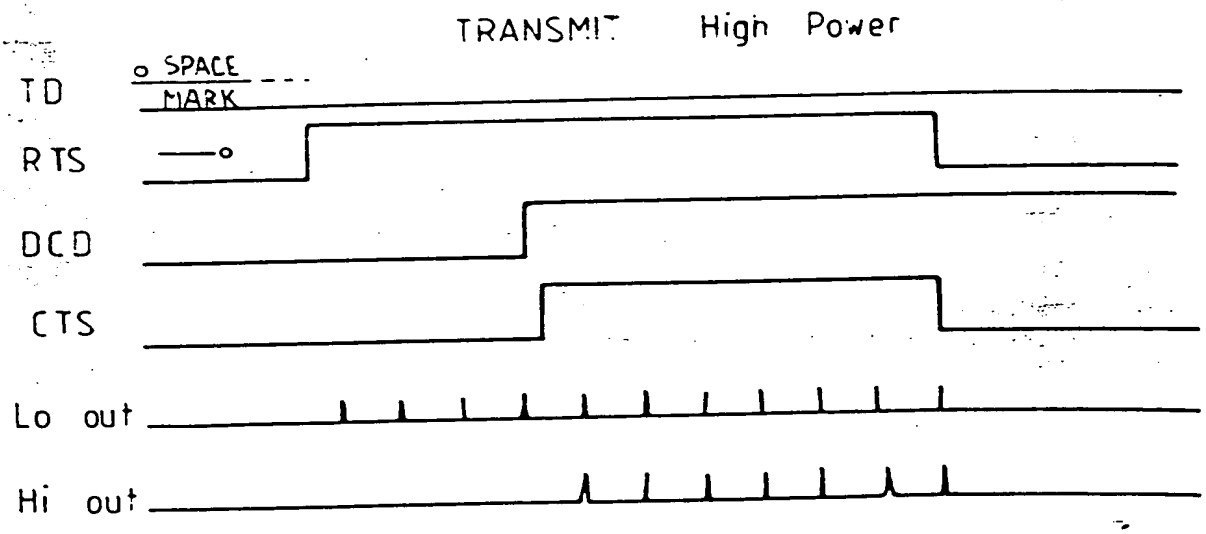
TRANSMIT High Power
TD
SPACE
MARK
RTS
DCD
CTS
Lo out
Hi out

FIG. 5.

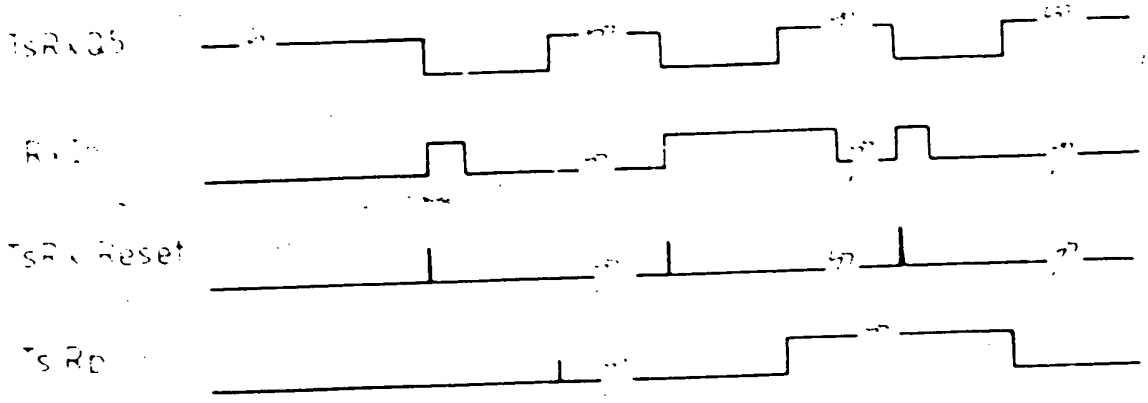

FIG. 6.

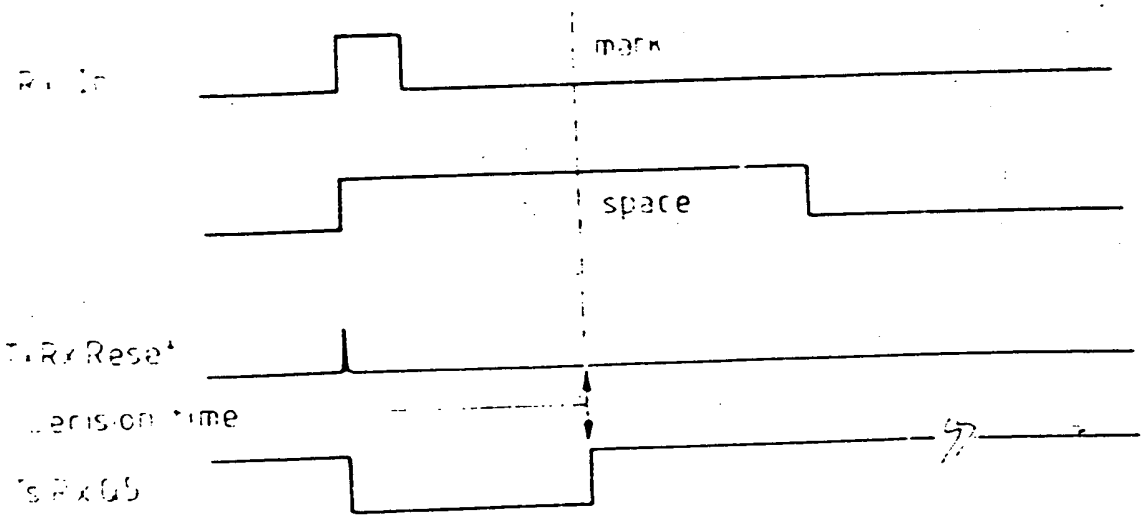

FIG. 7.